

Progress Toward CSO Control

King County has made significant progress in controlling CSOs during the past two decades. Despite fluctuations in rainfall from year to year, there is a pattern of decreasing volumes of CSO discharges over time (Figure 3-1).

This chapter describes the baseline used for measuring progress, explains how computer modeling and direct measurement are used to determine the frequency and volume of CSOs, and describes King County’s approach to controlling CSOs.

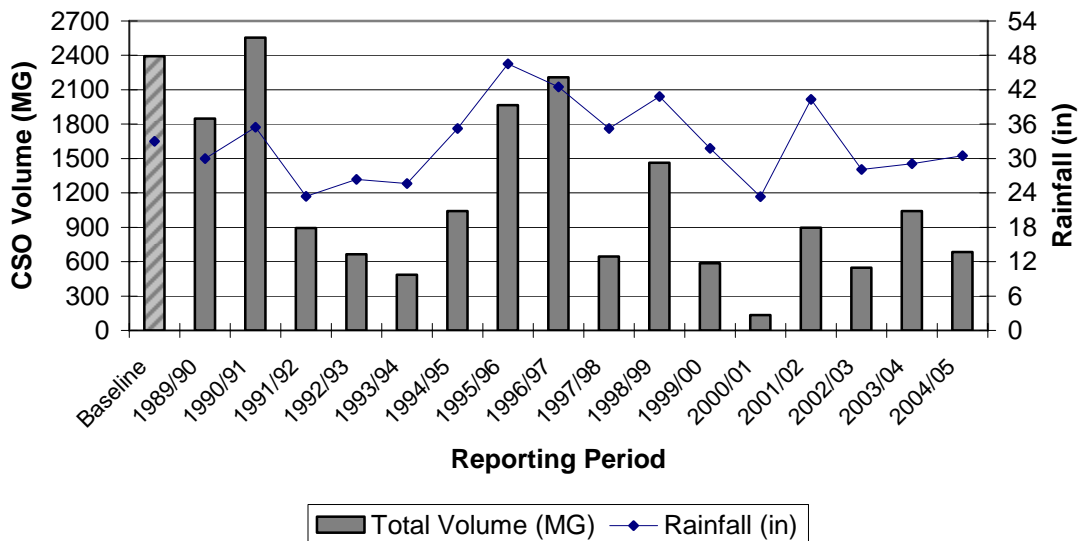


Figure 3-1. Annual CSO Volumes Relative to Total Rainfall

3.1 Measuring Progress in CSO Control

The Washington State Department of Ecology (Ecology) regulates the level of CSO control based on the number of untreated CSO events that occur in a year. Ecology defines “the greatest reasonable reduction” in CSOs (RCW 90.48) as being “control of each CSO in such a way that an average of one untreated discharge may occur per year” (WAC 173-245-020). Ecology recognizes that rainfall varies from year to year and thus assesses compliance with this goal as an average over the life of the National Pollutant Discharge Elimination (NPDES) permit for the CSO system, which is usually 5 years.

King County uses flow monitors in conjunction with a sophisticated supervisory control and data acquisition (SCADA) system to track both the frequency and volume of CSO events. The County models this and other information, such as rainfall patterns, to predict system behavior

and to plan for future CSO control facilities. The following sections describe King County's monitoring and modeling efforts, preceded by a discussion of how Ecology defines a CSO event.

3.1.1 Defining an Overflow Event

In order to determine whether King County is in compliance with Ecology's requirement to have no more than an average of one untreated discharge per year at each CSO location, it is necessary to define what constitutes a CSO event. A CSO event is defined by the length of the dry period (inter-event interval) after an overflow. Discharges are considered as one event, even if they start and stop several times during a storm, as long as the length of time between each discharge is less than the required inter-event interval. This definition of an event reflects the expectation that all overflows resulting from a single rainstorm should count as only one overflow. The County, in consultation with Ecology, developed and used a 48-hour interval for the RWSP modeling based on its analysis of local rainfall and the wastewater system's response to that rainfall.

Over the years, the interval used to define a CSO event has changed from 3 hours (1986–1995), to 48 hours (1995–2000), to 24 hours (2000 to present). The change to the 24-hour definition from the 48-hour definition resulted when Ecology decided to apply a single definition for all CSO agencies in the state. While the 24-hour definition fits some agency situations better than others because of variations in rainfall patterns, the change had only a minimal effect on the County's CSO control efforts.¹ Figure 3-2 gives an example of how an event is determined based on a 24-hour inter-event interval.

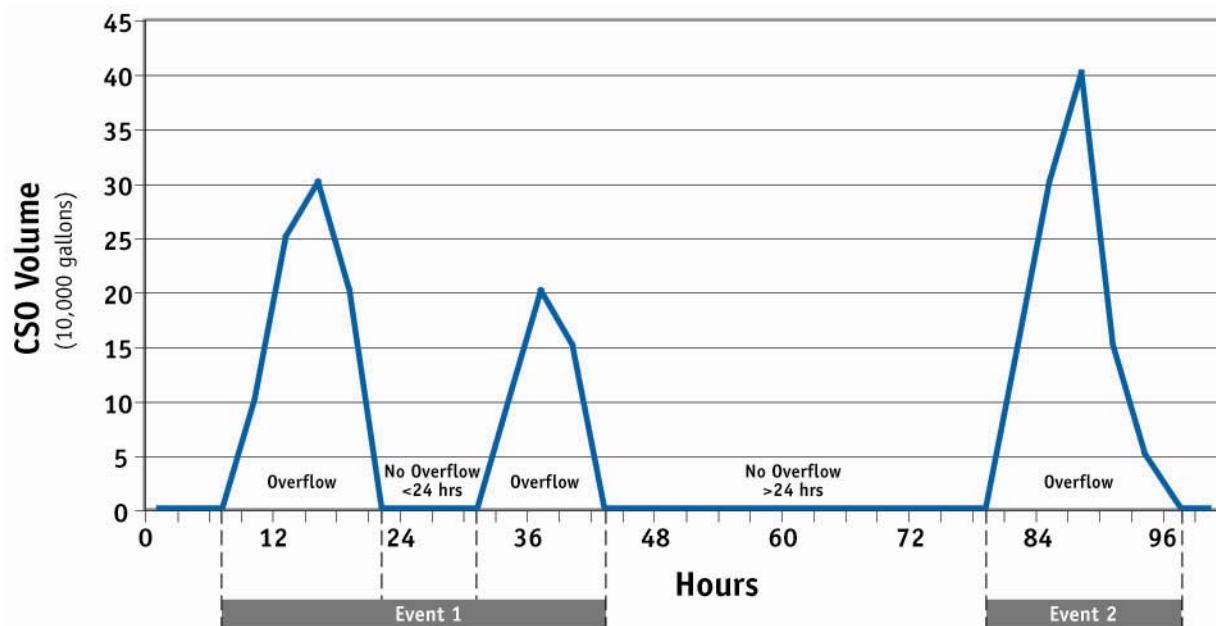


Figure 3-2. Defining CSO Events Using a 24-Hour Inter-Event Interval

¹ In the West Point NPDES permit, Ecology established that an event for **treated** CSOs would be defined based on a 48-hour inter-event interval.

3.1.2 CSO Monitoring and Modeling

King County uses both monitoring and modeling to assess the frequency and volume of CSOs. Monitoring consists of directly measuring overflows with flow meters or measuring the depth or flow level in a pipe with a known geometry and then using the data to calculate flow values. King County continuously monitors the frequency and volume of overflows at locations where flow control occurs within the wastewater system, such as at regulators or pump stations. Portable monitors, which must be manually downloaded at set time intervals, are used at other locations. Data collected from monitoring of actual overflows as they occur is used to determine compliance with Ecology regulations.

Because overflows vary with the pattern of rainfall from year to year, it is difficult to use monitored data to assess system capacity and progress in CSO control. One way to achieve consistency is to use a computer model to estimate the frequency and volume of overflows that would occur under average rainfall in the service area.² Modeled data is compared to monitoring data, and the model is calibrated (adjusted) to provide more accurate predictions for use in CSO program planning and facility design. (King County's approach to modeling is described later in this chapter.)

The County reports both monitored and modeled CSO data beginning in June of one year and ending in May of the next year; this approach reports on one continuous wet season rather than arbitrarily reporting the data based on calendar year. King County uses the period between 1981 and 1983 as the baseline for measuring progress in controlling CSOs. Baseline volumes were determined using computer modeling. The model used rainfall data from that period and other parameters, such as system capacity and the amount of permeable and impermeable surfaces in the service area at that time, to determine what the frequency and volume of CSO flows would have been. The 1981–1983 modeled baseline for the system is estimated as 471 CSO events (frequency) and 2,339 million gallons (volume) per year. The modeled prediction done in 1999 indicated a decrease from the baseline in frequency to 332 events and volume to 1,536 million gallons. Frequency and volume based on actual measurements for 2000–2005 were lower than these predictions—186 events and 736 million gallons per year on average—possibly because the rainfall for that period was lower than average. Table 3-1 compares the modeled estimates to the monitored frequency and volume for the 2000–2005 wet seasons

CSO Monitoring and Modeling

Flow Monitoring—A combination of flow monitors and a computerized control system tracks both the frequency and volume of CSO events.

Modeling—Computerized modeling programs use flow monitoring data and other data, such as rainfall patterns, to predict system behavior and to plan for future CSO control facilities.

Two major King County control systems, the Mercer/Elliott West and Henderson/Norfolk systems, came online in May 2005. Their effect on CSO control is not yet reflected in monitoring and modeling data reported in Table 3-1. It is anticipated that these systems will reduce untreated overflow volumes by one-third of the modeled 1999 prediction.

² King County rain gauges indicate that the average rainfall in the wastewater service area is 34 inches per year.

**Table 3-1. Annual Average Number and Volume of Untreated CSOs:
Monitored CSOs Compared to Modeled CSOs**

CSO Location	DSN	Frequency of Overflows			Volume of Overflows (annual average in million gallons)		
		Modeled Baseline 1981–1983	Modeled 1999	Monitored 2000–2005	Modeled Baseline 1981–1983	Modeled 1999	Monitored 2000–2005
11th Ave. NW	004	16	15	9	NA	18	5.06
30th Ave. NE	049	<1	<1	0	<1	<1	0.00
3rd Ave. W.	008	17	8	6	106	42	4.41
53rd Ave. SW	052	<1	<1	0	<1	<1	0.00
63rd Ave. PS	054	2	1	1	10	1	1.26
8th Ave./W. Marginal Way ^a	040	6	6	0	8	8	0.00
Alaska St. SW	055	1	1	0	<1	<1	0.00
Ballard	003	13	8	2	95	6	0.27
Barton	057	9	8	2	8	8	1.47
Belvoir	012	<1	<1	1	<1	<1	0.67
Brandon St.	041	36	28	25	64	49	34.59
Canal St.	007	<1	1	0	1	1	0.00
Chelan	036	7	7	3	61	32	1.40
Kingdome	029	29	10	7	50	79	28.51
Denny Way	027	32	24	21	502	449	298.96
Dexter	009	15	15	11	24	24	22.01
Duwamish Pump Station and Siphon, East	034	<1	1	0	<1	1	1.97
Duwamish Siphon, West ^b	035	Not modeled ^b	Not modeled ^b	Not monitored ^b	Not modeled ^b	Not modeled ^b	Not monitored ^b
Hanford #1 (Hanford @ Rainier)	031	30	11	5	378	65	11.90
Hanford #2	032	28	15	12	266	210	70.82
Harbor Ave.	037	30	26	1	36	36	7.48
Henderson	045	12	7	10	15	2	8.26
King Street	028	16	14	14	55	38	23.40
Lander St.	030	26	12	10	143	100	97.78

CSO Location	DSN	Frequency of Overflows			Volume of Overflows (annual average in million gallons)		
		Modeled Baseline 1981–1983	Modeled 1999	Monitored 2000–2005	Modeled Baseline 1981–1983	Modeled 1999	Monitored 2000–2005
Magnolia, S.	006	25	21	10	14	14	14.66
Marginal, E.	043	<1	<1	0	<1	<1	0.00
Matthews Park	018	<1	<1	0	<1	<1	0.00
Michigan St.	039	34	28	8	190	150	23.04
Michigan, W.	042	5	5	4	2	2	0.90
MLK Jr. Way	013	16	15	2	60	60	22.49
Montlake	014	6	5	5	32	32	29.68
Murray	056	5	5	3	6	6	2.72
Norfolk St.	044	20	4	2	39	5	0.48
North Beach	048	18	17	9	6	6	2.39
Pine St., E	011	<1	<1	0	<1	<1	0.00
Rainier Ave.	033	<1	1	0	<1	<1	0.00
Terminal 115	038	4	3	2	2	2	2.82
University	015	13	10	4	126	90	34.84
TOTAL		471	332	186	2,339	1,536	736.10

^a Recent data suggest that the 8th Avenue/West Marginal Way CSO may be controlled. King County is doing additional analysis to confirm this.

^b Duwamish Siphon West was reactivated in the NPDES permit in 2004 because of concerns that it could overflow. Monitoring is now in place.

NOTES:

- Shading indicates that a CSO is controlled to the Ecology standard of an average of no more than one untreated event per year.
- The County reports both monitored and modeled CSO data beginning in June of one year and ending in May of the next year.
- Baseline frequency modeling has been updated to the new 24-hour inter-event interval. Modeled 1999 frequency data, which are still based on a 48-hour inter-event interval, have not been updated.
- Modeling of the baseline (1981–1983) and for 1999 was done in 1999 using a continuous simulation model. Monitored data for 2000–2005 reflects the direct measurement of overflows.
- Modeled data predict what overflows would be under average rainfall conditions prior to completion of the Mercer/Elliott West and Henderson/Norfolk systems. These projects were completed in May 2005. Monitored data reflect CSOs under actual rainfall experienced during 2000–2005.
- Baseline and 1999 volumes are reported as whole numbers because they are modeled numbers. Volumes for 2000–2005 are reported to two decimal places because they reflect direct measurement of actual flows.
- Data that show <1 were not included in the total.

3.1.3 Approach to Modeling

WTD uses computer models to simulate stormwater and wastewater flow contributions to the wastewater system under various conditions. These simulations, combined with field data and engineering judgment, are used in the design and operation of facilities, such as CSO control facilities.

The different models that WTD has used over the past 30 years are described in Appendix B. For the RWSP, the types and sizes of CSO control projects were determined using a design storm model to predict average CSO frequencies and volumes. The design storm was representative of a storm of a specified volume, duration, and intensity that occurs once per year on average.³ WTD now uses a continuous simulation model that is based on historical rainfall patterns. The continuous simulation model simulates rainfall variability better than the design storm model and provides better long-term predictions of overflows. As the science of computer simulations improves and as more field data are collected over time, new calculations and more variables are added to the selected model to account for factors that affect the system. The revised model represents a more complete understanding of the system and results in more refined and accurate projections.

The evaluation done for this CSO program review indicates that the current model needs to be updated and recalibrated to ensure the accuracy of the predictions. Comparison between the modeled and monitoring data for 2000–2005 shows some significant differences between predicted and actual frequency and volume of CSOs (Table 3-1). Some of the differences are due to the lower than average rainfall over the 5-year period. The differences may also indicate that the wastewater system has changed in ways not captured by the model or may reflect inaccuracies in the monitored data resulting from the placement and/or operation of the monitors. In any event, because project sizing and the resulting cost of construction and operation rely on the modeled predictions, it is important for the model and measured data to be as accurate as possible. The updating and recalibration are under way and should be complete in 2007.

3.2 Approach to CSO Control

King County began to develop plans for controlling CSOs as early as 1979 (see Chapter 2). By May 2005, with completion of the projects specified in the 1988 plan and the Mercer/Elliott West and Henderson/Norfolk facilities, 17 of King County's CSOs were controlled to the Washington State standard of an average of no more than one untreated discharge per year per outfall. In meeting the Washington State standard, the federal standard of 4 to 6 events per year will also be met. The remaining 21 uncontrolled CSOs will meet state standards between 2012 and 2030. Strategies for reducing CSOs include pollution prevention through source control, operational controls, upgrade of existing facilities, and construction of new facilities to provide storage and treatment of excess flows prior to discharge. Figure 3-3 shows the estimated CSO reduction from 1988 through completion of the RWSP projects in 2030.

³ This design storm was called "Storm 6."

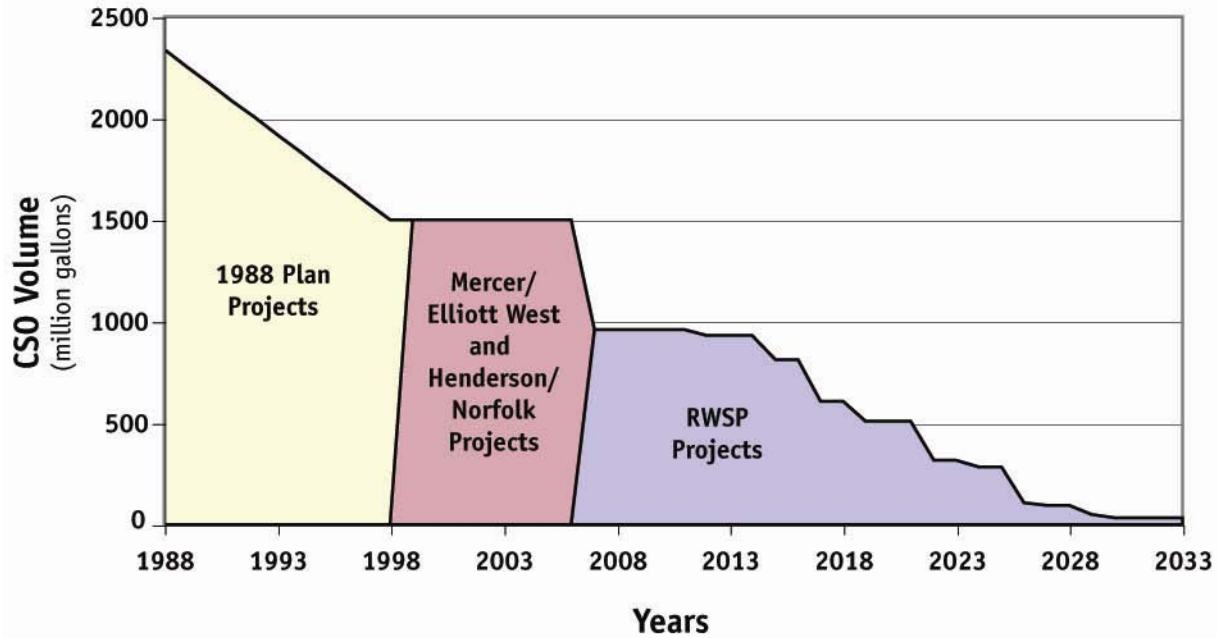


Figure 3-3. CSO Reduction Since 1988

3.2.1 Pollution Prevention and Source Control

CSO control strives not only to reduce the volume and frequency of discharges but also to prevent pollutants from entering the combined sewer system and discharging to receiving waters via CSOs. King County’s pollution prevention and source control efforts include the Industrial Waste Program and the Local Hazardous Waste Management Program. The County also participates in the Lower Duwamish Waterway Source Control Project. This project is pilot testing enhanced source control methods that if effective, could be added to future efforts.

3.2.1.1 Industrial Waste Program

The Industrial Waste Program administers King County’s industrial waste regulations for local businesses that discharge industrial wastewater to the King County sewer system. King County establishes local discharge limits; specific industries are subject to federal pretreatment requirements. Program activities include administration of waste discharge permits, inspections, enforcement, sample collection to determine compliance, and collection of surcharge and monitoring fees.

3.2.1.2 Local Hazardous Waste Management Program

WTD administers the multi-agency Local Hazardous Waste Program and funds 17 percent of the program. The goal of the program is to reduce the quantities of hazardous waste generated by households and small businesses and to divert these wastes from municipal waste streams and indiscriminate disposal in the environment. Program services include household hazardous waste education and collection; small business education, technical assistance, and compliance

assistance; small quantity generator collection and waste handling; an industrial materials exchange; and a hazardous waste library.

3.2.1.3 Stormwater Source Control

Stormwater source control is a key component of effective CSO control and prevention of sediment contamination. Stormwater management programs in the combined sewer area are operated by the City of Seattle. Until December 2005, the City conducted such programs only in the separated sewer areas. The City's new NPDES permit issued in December 2005 requires implementation of stormwater pollution prevention programs in the combined areas.⁴

3.2.1.4 Lower Duwamish Waterway Source Control Project

In 2002, King County, the City of Seattle, the Port of Seattle, and Boeing initiated the Lower Duwamish Waterway Source Control Project to increase the effectiveness of source control efforts in the Diagonal/Duwamish basin. The goal of the project is to ensure that the Lower Duwamish Waterway and Harbor Island/East Waterway Superfund sediment cleanup sites are not recontaminated. If source control in this basin is not successful, imposed solutions may include acceleration of CSO control project schedules or implementation of higher levels of control than is currently planned; either solution could require significant adjustment of the CSO control plan.

The size of this industrial area makes source control particularly challenging. Four separate programs implemented by King County Industrial Waste, King County Hazardous Waste, Public Health–Seattle and King County, and Seattle Public Utilities are now being coordinated to make it easier for businesses to identify and control pollutant sources. In the next few years, King County will determine if this approach has been successful; early monitoring of the remediated Diagonal/Duwamish site indicates that recontamination with phthalates is occurring. Additional source control efforts will need to be identified.

3.2.2 System-Wide Operational Controls

Since the early 1970s, one of King County's major tools in achieving CSO control is a SCADA system that the County has called CATAD (Computer Augmented Treatment and Disposal). The SCADA system monitors rainfall and conditions in major pipelines and then adjusts in-line regulator gates and pump speeds when flows reach predetermined "set points." The automatic control of the regulator stations significantly reduces CSOs by maximizing storage during a storm and then conveying the flows to West Point for treatment when the storm subsides. When needed, the automatic controls can be overridden by experienced operators at the West Point main control center.

King County continually modifies the SCADA system to take into account advances in computer modeling, to incorporate more recent field data, and to reflect modifications to the wastewater

⁴ These programs are required by the U.S. Environmental Protection Agency's (EPA's) Nine Minimum Controls. (See the discussion on the Nine Minimum Controls later in this chapter.)

system. For example, in 1992, storage levels behind regulator stations were raised to improve the capture of CSOs. Currently, a modified CSO drawdown strategy is being tested at the Interbay Pump Station that will provide additional storage capacity in the upper portion of the interceptor.

Over the last couple of years, SCADA system hardware and software at the West Point Treatment Plant have been replaced with a new system to bolster the reliability of monitoring and control of offsite regulator and pump stations. The new hardware includes enough capacity to install and run an optimization program, called Predictive Control, that can monitor rainfall and conditions in the major trunks and interceptors, predict inflows to the sewer system, and optimize the regulation of flow through the regulators to further minimize CSOs. Development and calibration of the Predictive Control model will occur in 2005–2007; a new updated control program is expected in 2007–2009. These and other improvements could reduce CSO volumes by as much as 150 million gallons per year.

3.2.3 CSO Control Projects

To reduce the discharge of CSOs into area water bodies, King County has completed sewer separation projects and has constructed storage, conveyance, and treatment facilities.

New storage tunnels hold combined sewage until a rainstorm subsides and capacity opens up in the conveyance and treatment system. Then as much flow as possible is sent to the regional plants for secondary treatment. Flows that cannot be stored either receive primary treatment (physical settling of solids, disinfection, and dechlorination) at CSO treatment facilities or are discharged untreated to area water bodies. CSO treatment facilities are built to directly serve the areas where they are located; they operate only during heavy rainfall. King County CSO treatment facilities include the Alki and Carkeek CSO Treatment Plants and two facilities completed in May 2005—the Mercer/Elliott West and the Henderson/Norfolk CSO control systems.

As described in Chapter 2, the RWSP identified 21 CSO control projects scheduled for completion by 2030. These projects will provide steady progress toward bringing King County into compliance with Ecology regulations for control of CSOs. The projects were prioritized in the RWSP based on protection of human health, endangered species, and the environment. New information available since the RWSP supports these priorities. The next projects to be implemented—Barton, Murray, North Beach, and Magnolia—are the Puget Sound beach projects at locations having the highest recreational uses. These beach projects are scheduled for completion in 2012. Updated modeling will be done for these projects to provide information needed for predesign in mid 2006. Low-interest State Revolving Fund (SRF) loans from Ecology have been awarded to fund the bulk of predesign for Murray, Barton, and North Beach; Ecology has encouraged King County to resubmit its application for Magnolia during the next loan cycle. Monitoring indicates that the SW Alaska Street CSO is not needed because the location is already controlled.

Completed CSO control projects are shown in Table 3-2. Projects done primarily for other reasons, but with CSO control benefits, are shown in Table 3-3. The more significant projects shown in the table are discussed in the sections that follow.

Table 3-2. Completed CSO Control Projects

Project	Description	Year Completed	Status
Ft. Lawton Tunnel	Parallel tunnel to West Point to provide greater transfer capacity.	1991	Completed.
SCADA (CATAD) System Improvements	Improvements to the system that controls flows and maximizes storage in pipelines.	Ongoing	Recent improvements will be completed in 2009 with completion of the upgrade of the Interbay Pump Station and implementation of upgraded computer control. Maintenance and improvement will be ongoing.
Hanford/Bayview/Lander Separation & Storage	Partial separation of the Lander and Hanford basins, and reactivation of Bayview Tunnel. (Joint project with the City of Seattle.)	1992	Remaining control will occur under RWSP projects in 2017 (Hanford), 2019 (Lander), and 2026 (Hanford at Rainier). Lander stormwater management is ongoing.
Carkeek Transfer/CSO Treatment	Transfer to West Point of flows up to 9.2 mgd from the Carkeek drainage basin. Treatment of flows above 9.2 mgd at the Carkeek CSO Plant.	Online in 1994; upgrades in 2005; dechlorination began in 2006	Because the Carkeek plant was receiving more flow than anticipated, pumping capacity at the Carkeek Pump Station was upgraded from 8.4 to 9.2 mgd in 2005 to send more flows to West Point. Dechlorination was started in 2006 to comply with 2005 NPDES permit modifications.
University Regulator/Densmore Drain	Separation of Densmore & I-5 stormwater, as well as Green Lake drainage.	1994	Remaining control will occur under an RWSP project in 2015. Densmore stormwater management is ongoing.
Kingdome Industrial Area Storage & Separation	Installation in 1994 of a storage pipeline in conjunction with Seattle and WSDOT street projects. In 1999, the Public Facilities District (PFD) completed separation between Alaska Way and 3 rd Ave. in conjunction with Safeco Field construction.	1994; 1999	Remaining control will occur in 2026 under an RWSP project.
Harbor Pipeline	Installation of a pipeline that conveys excess flow from the Harbor regulator to the West Seattle Tunnel for storage.	1996; activated in 2000/01	

Project	Description	Year Completed	Status
Alki Transfer/CSO Treatment	Transfer to West Point of flows up to 18.9 mgd from the Alki drainage basin via the West Seattle Tunnel. Treatment of flows above 18.9 at the Alki CSO plant.	1998; dechlorination began in 2006	Additional CSO plant modifications were completed in 1999. Dechlorination was started in 2006 to comply with 2005 NPDES permit modifications.
63 rd Ave. Pump Station	Diversion of excess flow to the West Seattle Tunnel or Alki CSO Plant.	1998	
Denny Way/Lake Union (completed system is called Mercer/Elliott West)	Storage and primary treatment of Lake Union flows in the Mercer Tunnel, with screening, disinfection, and discharge at Elliott West.	2005	Construction of major facilities was completed; startup is under way.
Henderson/MLK/Norfolk (completed system is called Henderson/Norfolk)	Storage, primary treatment, and disinfection of Henderson and MLK flows in the Henderson Tunnel; transfer of flows to secondary treatment plants; discharge of excess treated CSOs at Norfolk.	2005	Construction was completed; startup is under way.

Table 3-3. Completed Associated Projects

Project	Description	Completion	Status
Renton Sludge Force Main Decommissioning	Before South plant developed solids management capability, sludge was pumped via the Elliott Bay Interceptor to West Point for processing; decommissioning of the force main may have decreased solids discharge from the Interbay Pump Station at the Denny CSO.	1988	Completed.
Ballinger and York Pump Stations	Construction of two new pump stations so that flows can be diverted to and from the West Point collection system. Flows are currently diverted away from West Point during the wet season.	1992 (York Pump Station); 1993 (Ballinger Pump Station)	Completed.
West Point Treatment Plant Expansion	Increase in plant hydraulic capacity from 325 mgd to 440 mgd to enable conveyance and treatment	1995	Completed.

Project	Description	Completion	Status
	of more flow from the combined sewer system.		
Allentown Diversion/Southern Transfer	Designed to offset addition of Alki flows to the Elliott Bay Interceptor. Side-benefit of significant volume reduction at Norfolk.	1995	Completed.
North Creek Pump Station	Diverts flow to the South plant collection system during wet weather.	1999	Completed.

3.2.3.1 Upgrade to Secondary Treatment at West Point Plant

In 1995, the West Point Treatment Plant was upgraded to provide secondary treatment of wastewater flows. The plant has enough capacity to provide treatment of about 140 mgd of CSO flows beyond the level required for CSO treatment. The CSO flows receive primary treatment and then are mixed with secondary effluent before disinfection, dechlorination, and discharge from the deep marine outfall. The resulting effluent meets secondary effluent quality limits; during the wet season, however, a small allowance is made in the percent removal limits for biological oxygen demand and total suspended solids.⁵ A total of 352 million gallons of captured CSOs received this kind of treatment in 2004–2005.

3.2.3.2 Carkeek and Alki CSO Treatment Plants

When it was originally constructed, the Carkeek CSO Treatment Plant was a primary treatment plant serving the local area. When the Clean Water Act of 1972 required agencies to provide secondary treatment of wastewater, Metro decided to transfer the base local flows to West Point for secondary treatment and to redesign the Carkeek plant to provide CSO treatment of excess combined flows from the service area. The transfer and conversion were completed in 1994.

During its first NPDES permit cycle of operation, the Carkeek plant exceeded the frequency and volume limits set in the permit. The Carkeek Overflow Reduction Study, completed in 2003, found that the local service area was sending more flow to Carkeek than was expected when the plant was designed. In 2005, the pumping capacity of the Carkeek Pump Station was upgraded from 8.4 to 9.2 mgd to increase the volume of flows conveyed to West Point for secondary treatment and discharge. Ecology modified the NPDES permit limits to reflect these new conditions. Flows in excess of 9.2 mgd are stored at Carkeek. Stored flows that cannot be sent to West Point receive treatment, disinfection, and dechlorination before being discharged to Puget Sound. In 2004–2005, the Carkeek plant discharged CSO flows four times; the total volume was 4.04 million gallons.

Similar to Carkeek, the Alki CSO Treatment Plant originally provided primary treatment to local flows. Since 1998, base flows are transferred to West Point to meet secondary requirements and

⁵ From November through May, 80 percent removal is allowed rather than the 85 percent required during the dry season.

the Alki plant provides CSO treatment to excess combined flows. While the system was designed to discharge treated CSO flows from the Alki plant approximately 29 times per year, the Alki plant operates on average only 2 times per year. The West Seattle Tunnel, completed in 1998, has allowed much of the flow to go to West Point via the Elliott Bay Interceptor. This increased transfer of Alki area flows to West Point has resulted in occasional permit compliance problems. The remaining two events per year occur under the largest storms, and so are the most dilute and difficult to treat. Discussions with Ecology are scheduled to begin soon.

3.2.3.3 Mercer/Elliott West CSO Control System

The Mercer/Elliott West CSO control project was a joint effort of King County and the City of Seattle to control CSOs into Lake Union and Elliott Bay. After 12 years of planning and more than 4 years of construction, the project was completed in May 2005. The completed system includes several elements:

- The Mercer Street Tunnel, a 14.7-foot-diameter storage and treatment tunnel running more than a mile under Mercer Street through the base of Queen Anne Hill.
- The Elliott West CSO Control Facility for transferring flows to West Point or for additional treatment of flows that exceed the capacity of the tunnel.
- One new outfall extending up to 340 feet offshore and 60 feet deep in Elliott Bay; a second short outfall for flows in excess of the capacity of the Mercer/Elliott West system (expected to discharge no more than once per year on average).

During small and moderate storms, the new system stores flows in the Mercer Street Tunnel. After a storm subsides and when capacity is available, the system sends the flows to the West Point Treatment Plant for treatment. During major storms, when the volume of flow exceeds the storage capacity in the tunnel, the excess flows, having received primary settling in the tunnel, are conveyed to the Elliott West CSO Control Facility, where they are screened, disinfected, and dechlorinated prior to discharge into Elliott Bay. When capacity is available again, the flows and settled solids in the tunnel drain to West Point for further treatment.

The new facilities will reduce both the volume and the frequency of untreated overflows into Lake Union and Elliott Bay. It is predicted that the number of untreated CSO discharges from the Denny Way Regulator into Elliott Bay will be reduced from a previous average of 32 per year to 1 per year,⁶ and the number of treated CSO discharges will be approximately 14 to 20 per year. This significant reduction in untreated CSO frequency and volume will likely result in immediate and long-term improvements in water quality in Lake Union, Elliott Bay, and Puget Sound.

⁶ In the facilities plan for this project, the average number of CSOs was estimated at 50 per year. The different number shown in this chapter (32 per year) reflects a change in modeling approach and inter-event interval definition since the preparation of the facilities plan.

3.2.3.4 Henderson/Norfolk CSO Control System

The Henderson/Norfolk CSO control project, also completed in May 2005, is similar to the Mercer/Elliott West system. It will reduce the discharge of untreated combined sewage to Lake Washington and the Duwamish River. The completed system includes several elements:

- The Henderson Tunnel, a 14.7-foot-diameter storage and treatment tunnel running two-thirds of a mile under 42nd Avenue South on Beacon Hill.
- More than 2 miles of tunnels and pipelines under South Henderson Street and South Norfolk Street from Lake Washington to the Duwamish River at the Norfolk CSO.
- Expansion of the pumping capacity of the Henderson Pump Station near Lake Washington from 7.5 to 20 mgd.

During storms, the new system stores excess flows in the Henderson Tunnel. After a storm subsides and when capacity is available, the system sends the flows to the South Treatment Plant for treatment. During major storms, when the volume of flow exceeds the storage capacity in the tunnel, the excess flows receive primary settling, screening, and chlorination and dechlorination in the tunnel, and then are conveyed to the Norfolk outfall, where they are discharged to the Duwamish River. When capacity is available again, the flows and settled solids in the tunnel drain to the South plant for further treatment.

The number of untreated CSO discharge events from the Henderson CSO to Lake Washington will be reduced from an average of 12 per year to less than 1 per year. Overflows from the Martin Luther King, Jr., CSO to Lake Washington will be reduced from an average of 16 per year to less than 1 per year. The number of untreated CSO discharge events from the Norfolk CSO to the Duwamish River will be reduced from an average of 20 per year to 1 per year; approximately 2 to 4 treated discharges will occur at Norfolk.⁷ The reduction in untreated CSO frequency and volume will likely result in immediate and long-term improvements to water quality in Lake Washington and the Duwamish River.

3.3 Implementation of EPA CSO Control Regulation

EPA's 1990 CSO Control Policy was codified as the Wet Weather Water Quality Act of 2000 (H.R. 4577, 33 U.D.C. 1342(q)). This act requires implementation of Nine Minimum Controls for CSOs and the development of long-term CSO control plans. The initiation of the CSO Control Policy in 1990 occurred well after the enactment of Washington State CSO regulations. At the time, King County was already implementing most of the policy elements and needed only to identify and document existing practices in order to comply with EPA's policy.

⁷ In the facilities plan for this project, the average numbers of CSOs at the Henderson, MLK, and Norfolk locations were estimated at 11, 15, and 20 per year, respectively. The different numbers shown in this chapter reflect a change in modeling approach and inter-event interval definition since the preparation of the facilities plan.

3.3.1 Nine Minimum Controls

EPA's Nine Minimum Controls were developed to provide early and relatively inexpensive actions to improve water quality without having to wait for completion of the more expensive capital projects. When they were published, the Nine Minimum Controls packaged and codified elements, including CSO-specific elements, contained in the operations and maintenance programs of well-run wastewater management programs. Most of them were already standard practice in the King County system.

Table 3-4 describes King County actions that implement the Nine Minimum Controls and supplemental actions that will be implemented to comply with the recent modification to West Point's NPDES permit.

3.3.2 Long-Term Control Plan

The requirements of the EPA Wet Weather Water Quality Act are similar to Washington State CSO regulations. Under both, compliance with the state Water Quality Standards (WAC 173-201A) must be achieved. However, King County may need to provide documentation of CSO control activities in a manner that meets EPA expectations. The state-mandated CSO control plan will be modified, as needed, so that the plan complies with both regulatory programs. The Wet Weather Water Quality Act is implemented through NPDES permits, and any additional changes in permit requirements will occur in the next NPDES permit for the West Point Treatment Plant, scheduled to occur in 2008.

Table 3-4. King County's Compliance with EPA's Nine Minimum Controls

Nine Minimum Controls	King County Compliance Effort
Control 1. Proper operation and regular maintenance programs for the sewer system and CSOs	King County regularly maintains CSO outfalls, regulator stations, and pump stations through the West Point Treatment Plant, South Treatment Plant, and collection system maintenance divisions. Proper facility operation is managed by West Point staff using the SCADA system. ^a Collection system staff inspect sewers on a specified schedule and perform corrective actions when deficiencies are found. Maintenance schedules and records of visits are available for inspection upon request.
Control 2. Maximize use of collection system for storage	The SCADA system manages regulator stations to maximize flows in interceptors and to store excess flows in large trunk sewers.
Control 3. Review and modification of pretreatment requirements to ensure that CSO impacts are minimized	King County's Industrial Waste Program issues permits that set limits on the chemical contents of industrial discharges. The program also includes monitoring and permit enforcement, education, and technical assistance to businesses on appropriate waste pretreatment and disposal techniques. King County also administers and helps fund the Local Hazardous Waste Management Program. Current water quality assessment and sediment management plan data indicate that there is no need for CSO-specific pretreatment program modifications.
Control 4. Maximization of flow to secondary treatment plant for treatment	The SCADA system is used to maximize flow to the West Point Treatment Plant by operation of regulator and pump stations. All analyses completed for CSO control project alternatives include varying the levels of storage and transfer to the secondary treatment plants.

Nine Minimum Controls	King County Compliance Effort
Control 5. Elimination of CSOs during dry weather	King County's maintenance and operation programs focus on preventing dry-weather overflows. Dry-weather overflows may occur as a result of equipment malfunction or loss of power. The conveyance system is monitored through the SCADA system, and corrective action is taken immediately if a problem occurs. Equipment problems are immediately reviewed, and repair or replacement activity is undertaken in a timely manner. Dry-weather overflows are reported to Ecology as sanitary sewer overflows.
Control 6. Control of solid and floatable materials in CSOs	City of Seattle street sweeping and catch basin maintenance limit introduction of floatable materials to sewers. Procedures to record observations of floatable materials are being revisited.
Control 7. Pollution prevention programs to reduce contaminants in CSOs	King County has implemented both the Industrial Waste Program and the Local Hazardous Waste Management Program to reduce discharge of chemicals and other substances that adversely impact the environment and the wastewater treatment process. These programs have received national recognition.
Control 8. Public notification program to ensure that public receives adequate notice of CSO events and impacts	King County, the City of Seattle, and Public Health–Seattle and King County have undertaken a joint public outreach effort to inform the public about the location of CSOs, their actual occurrence, and the possible health or environmental impacts of CSOs. The outreach effort includes a CSO posting and public notification program. Signs have been posted near CSO outfalls stating, "WARNING: Possible Sewage Overflows During and Following Heavy Rain." The drawing on the signs warns people to not swim or fish at these outfalls during or following rainstorms. In addition, the outreach effort includes media releases and a brochure, fact sheet, Web site (www.metrokc.gov/health/hazard/cso.htm), and CSO information telephone number (206-205-1151) to answer health concerns about CSOs. The recently modified NPDES permit requires King County to conduct a study to determine the feasibility of providing more immediate notification of overflows, including the feasibility of providing a Web-based system. A draft report is due to Ecology by July 1, 2006; a final report is due by July 1, 2007. The City of Seattle's NPDES permit renewal contains a similar requirement. The County and the City will discuss the possibility of working together to produce a joint program, as they did for the original CSO Notification and Posting Program.
Control 9. Monitoring to effectively characterize CSO impacts and the efficacy of CSO controls	Under the 1988 CSO Plan, King County's sampling program (now complete) included collecting data for five CSO sites per year. The King County 1999 <i>CSO Water Quality Assessment</i> found that the majority of risks to people, wildlife, and aquatic life would not be reduced by removal of CSOs in the Duwamish River and Elliott Bay because most risk-related chemicals come from sources other than CSOs. King County may undertake additional sampling on completion of specific CSO control projects.

^a The supervisory control and data acquisition (SCADA) system controls the West Point Treatment Plant collection system. See the discussion of the SCADA system in this chapter.